AN-010 API Interface Specification

OmniPreSense modules have an easy to use API to control the output of the modules. The simple commands can be used to configure the operation and output information provided by the module. Default settings are noted below. Upon powering on the module, the default settings are used.

Terminal Control

A simple Command Terminal can be used to control the module operation with the API commands. Examples of simple but very useful Command Terminals are Tera Term and PuTTY. Both are free, open source terminal tools for the PC/Mac which can easily connect to a serial port and accept data over USB from the OmniPreSense module.

To begin using the OmniPreSense module, first download Tera Term or PuTTY onto your PC/Mac. With the OmniPreSense module plugged into the USB port of your PC/Mac, start Tera Term or PuTTY. A configuration window such as in Figure 1 or Figure 2 will appear. Tera Term can detect the active COM port (greyed out to right of Serial button if TCP/IP is selected). Select the Serial button and press OK. For PuTTY, you'll need to know which COM port is used, set its value, select the Serial button, and Open.

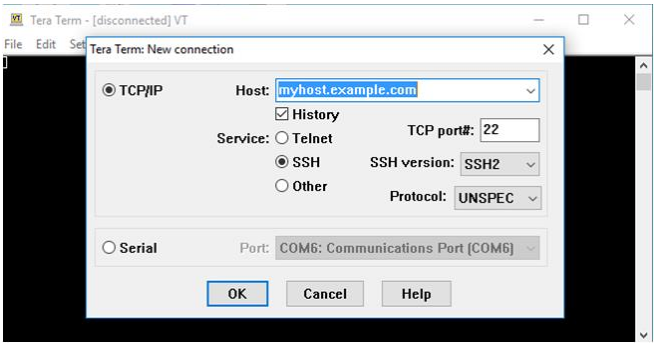

Figure 1. Tera Term Startup Menu

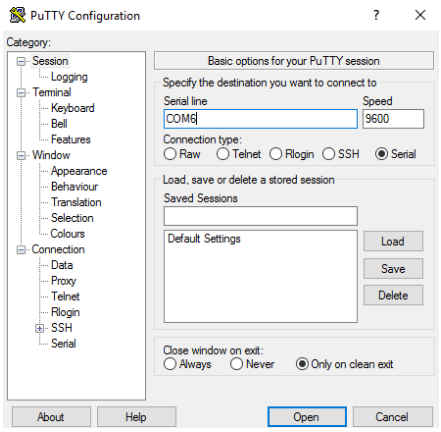

Figure 2. PuTTY Startup Menu

Once connected, the data reported by the module will start streaming to the terminal when an object in motion appears. The default settings are shown in Table 1. If there is no object moving in front of the module, no data is reported or streamed to the terminal. A simple wave of the hand will show data like that shown in Figure 3. Any of the API commands can now be executed to change the output data or query the configuration.

Figure 3. Streaming Data with Tera Term

Figure 4. Streaming Data with PuTTY

Default Settings

The default settings of the module are set to provide solid performance over a wide range of applications. Upon power-up the default settings are used, and operation begins. Future updates will allow the module to retain the settings of the module from the last operation. The default settings are listed in Table 1.

Table 1. Default Settings

API Command	API Command	Default Value
Output Units	UM	m/s
Data Accuracy	F2	2
Sample Rate	SX	10,000
Sample Buffer Size	S>	1024
Simple Motion Interrupt	IG	Off
Reported Speed Filter	R>*n*, R<*n*	Off
Reported Direction Filter	R|	Off
Magnitude Filter	M>*n*, M<*n*	>10
JSON Output	Oj	Off
LED Control	OL	On
Magnitude Report	Om	Off
Number Reports	O*n*	1
Raw Data Output	Or	Off
Speed Report	OS	On
Time Report	Ot	Off
Module Power	PA	Active

Operating Range

The maximum speed reported is determined by the Sampling Frequency. For slow moving objects, a sample rate of 5,000 (SV command) is perfectly fine. The default setting of 10,000 (SX command) provides a detectable speed of up to 31.1 m/s (69.5 mph) while 20,000 (S2 command) provides up to 62.2 m/s (139.1 mph). The resolution of the reported speed increases as the sample frequency goes down. The range of values is summarized in Table 2.

Table 2. Maximum Operating Speeds

Sample Frequency	API Command	Maximum Speed (m/s)	Maximum Speed (mph)	Accuracy* (m/s)	Accuracy* (mph)
1,000	SI	3.1	7.0	0.006	0.014
5,000	SV	15.5	34.8	0.030	0.068
10,000	SX	31.1	69.5	0.061	0.136
20,000	S2	62.2	139.1	0.121	0.272
50,000	SL	155.4	347.7	0.304	0.679
100,000	SC	310.8	695.4	0.608	1.358

* 1024 buffer size, 512 buffer size accuracy will be twice these values, 256 four times

API Commands

The following are the API commands supported by the OPS241 and OPS242. These commands can be sent by typing into the command terminal to change settings on the module or control its operation. The commands provided include simple queries to fetch information about the module and its settings or write commands which control or change the operation of the module.

Module Information – returns information about the module and its setting.

Command	Name	R/W	Value
??	Module Information	Read	{"Product":"OPS242"} {"Version":"1.3.0"} {"SamplingRate":10000, "resolution":0.0607} {“SampleSize”:1024} {"Clock":"54"} {"Q2COUNT":"1149 (~22980 counts/sec) @t=37"} {"PowerMode":"Continuous"} {"Squelch":"100"} {“RequiredMinSpeed”:”0.000”}
?R	Reset Reason	Read	Provides the reason why sensor reset. { "ResetReason": "Status from bitmask", "POWER_ON" : true, "SUPPLY_WATCHDOG" : true, "POWER_VALIDATION" : true }

Module Part Number – returns model number of modules as either OPS241 or OPS242.

Command	Name	R/W	Value
?P	Module Part Number	Read	{"Product":"OPS242"}

Firmware Version/Board ID – returns current firmware version of the module. Firmware version consists of a major revision, minor revision, and patch revision in the form of xx.yy.zz.

Command	Name	R/W	Value
?V	Firmware Version Number	Read	{"Version":"1.3.1"}
?B	Firmware Build Number	Read	{"Build":"20181005_1335"}
?U	Unique Board ID	Read	{"UID":"b2000040b7a12400d5188041"}

Speed Output Units – read or set the units for the velocity output. Units supported include m/s (default), cm/s, ft/s, km/hr, and miles per hour.

Command	Name	R/W	Value
U?	Current Velocity Units	Read	{"Units":"m-per-sec"}
UC	Centimeters per second	Write	{"Units":"cm-per-sec"}
UF	Feet per second	Write	{"Units":"ft-per-sec"}
UK	Kilometers per hour	Write	{"Units":"km-per-hr"}
UM	Meters per second	Write	{"Units":"m-per-sec"}
US	Miles per hour	Write	{"Units":"mph"}

Data Precision – set the number of digits for the data reported.

Command	Name	R/W	Value
F*n*	Decimal Places	Write	Set *n* to the number of decimal places to be reported. For example, setting to F2 will report 2 decimal places (ex. 10.35). F0 will provide the integer value only. Valid values of *n* are 0-5.
F?	Decimal Place Setting	Read	Query the number of decimal places set.

Sampling Rate/Buffer Size – set these values to control the sample rate of the module. This setting influences the output data and the rate at which the data is reported. The buffer size influences the report rate and resolution. A buffer size of 512 will have a report rate between 5-30Hz. The resolution becomes worse by a factor of two with a 512 buffer size versus 1024 (Figure 5) and worse again at 256 buffer size.

Command	Name	R/W	Notes
SI	1K samples/second	Write	
SV	5K samples/second	Write	
SX or S1	10K samples/second	Write	
S2	20K samples/second	Write	
SL	50K samples/second	Write	
SC	100K samples/second	Write	
S>	1024 buffer size	Write	1024 samples are collected before processing
S<	512 buffer size	Write	512 samples are collected before processing
S{	256 buffer size	Write	256 samples are collected before processing

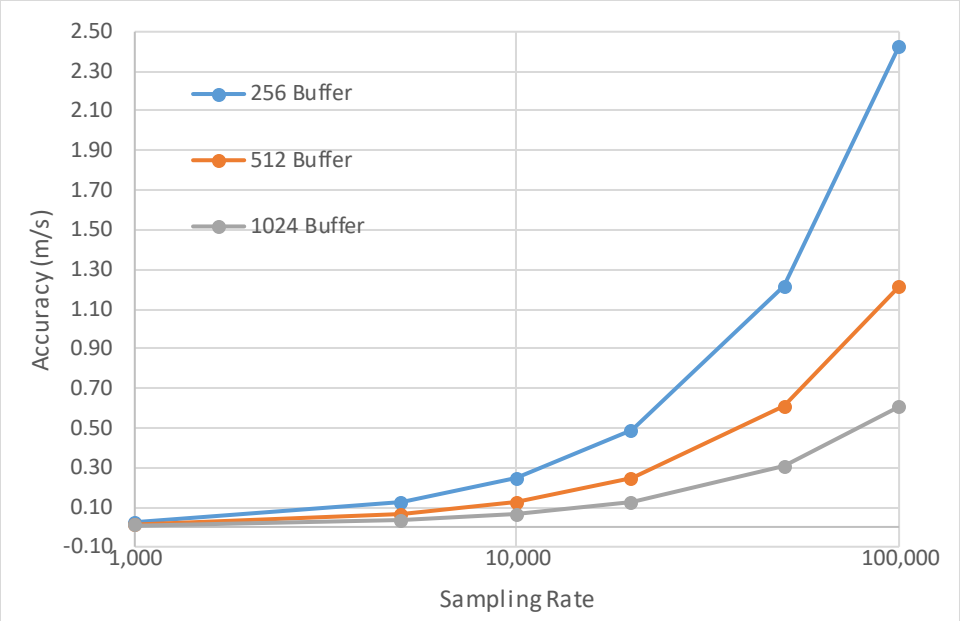

Figure 5. Buffer Size versus Accuracy

Reported Speed/Direction Filter – use these settings to set the minimum or maximum value or direction to report. Reported speed can be used to set the sensitivity level of detection. Any values below or above the number *n* will not be reported. This command requires a return (↵) after the number. Direction filter allows reporting only a single direction or both.

Command	Name	R/W	Notes
R>*n*	Reported Speed Filter	Write	*n* is any number upon which no detected speeds below that number will be reported. R>0 resets to no limit.
R<*n*	Reported Speed Filter	Write	*n* is any number upon which no detected speeds above that number will be reported. R<0 resets to no limit.
R+	Inbound Only Direction	Write	Only reports inbound direction
R-	Outbound Only Direction	Write	Only reports outbound direction
R|	Clear Direction Control	Write	Reports both directions

Frequency Control – use this setting to set the desired transmit frequency. Set *n* to a positive or negative number to set the frequency. T=0 is the default setting targeting 24.125GHz. Each increment steps approximately 18MHz. The programming steps are limited to 24.0 through 24.25GHz for the OPS242 and 25.6GHz operation for the OPS241. The limits on *n* are -6 (24.0GHz) and 93 (25.6GHz) for the OPS241 and -2 (~24.0GHz) to 2 (~24.25GHz) for the OPS242 which has some guard banding to ensure it stays within the 24.0-24.25GHz ISM band. See Figure 6 for approximate values of *n* for each frequency. Depending on the spread between the current frequency and the newly set frequency, there may be a long settling time on the order of 5-10 seconds or longer based on the size of the jump in values. Writing ?F will provide the current transmitter output frequency.

Command	Name	R/W	Value
T=*n*	Frequency Setting	Write	T=0 is the default setting for 24.125GHz.
?F	Frequency Output	Read	?F returns the output frequency of the transmitter in GHz.

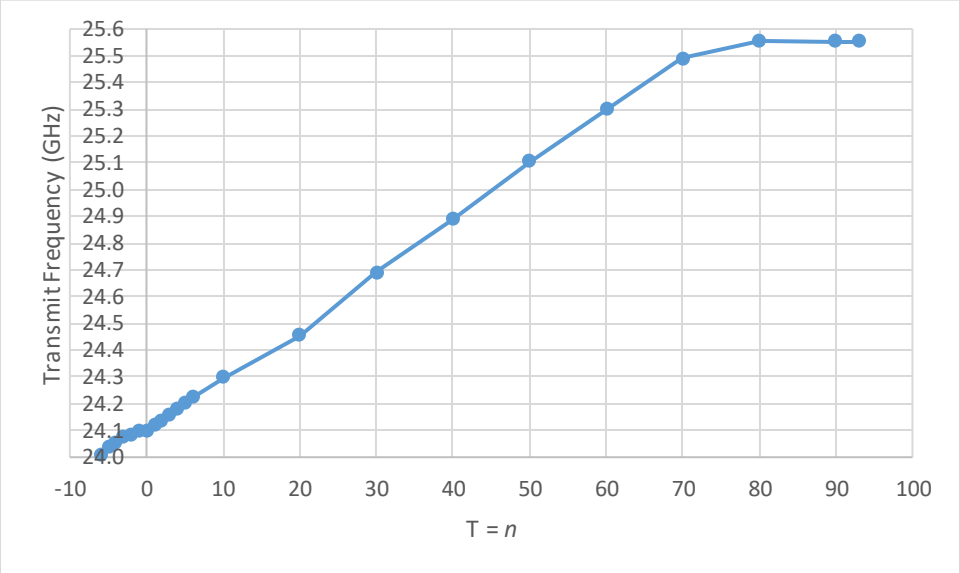

Figure 6. Frequency Setting T Values

Data Output – set to control the data which is output.

Command	Name	R/W	Value
OF	FFT Output On	Write	Results from the FFT processing of each buffer will be sent. Each buffer is 1024 samples. Data is output with json output format. Use Of to turn it off.
OJ	JSON Mode On	Write	Turns on output to format data in JSON format. An example would output: {"speed":0.58, "direction":"inbound", “time”:105, :tick”:135}. Use Oj to turn off JSON mode.
OR	Raw ADC Output On	Write	I and Q output buffers from the ADC will be sent. Data output will alternate between the I and then Q buffer. Or turns off raw ADC reporting.
OL	LED Control	Write	Turn the LEDs on (OL) or off (Ol). Turning off the LED’s can save approximately 10mA of current consumption.
O*n*	Number Reports	Write	Define how many reports to provide. *n* is a number between 1 and 9. The number *n* applies to magnitude and speed reports.
OM	Magnitude Report	Write	Turn on reporting of the magnitude associated with the speed. The magnitude is a measure of the size, distance, and reflectivity of the object detected. Type Om to turn magnitude off. When turned on, magnitude information comes before speed information.
OS	Speed Report	Write	Turn speed reporting on or off. Default operation speed is reported. Use Os to turn it off and OS to turn it back on.
OT	Time Report	Write	Turn the time report on. Time is reported as the seconds and milliseconds since the last reboot or power on. For example, 137.429, 3.6 is read as 137 seconds and 429 milliseconds with a speed of 3.6 m/s. If magnitude is turned on, the data is provided as time, magnitude, speed.
BZ	Zero Blank Reporting	Write	If measured data does not meet filtering criteria, sensor will report out a zero value with every sampling interval. Use BV to turn this feature off. BL will report blank lines.

UART Control – set to control the UART reporting format. The default configuration is 8-bits, no parity, and 1 stop bit. The OPS241 and OPS242 will start reporting out on the UART immediately after power on. If the USB is enumerated, the UART reporting will be shut off and data will be reported out USB.

Command	Name	R/W	Value
I?	Query Baud Rate	Read	Outputs current baud rate and oversampling setting.
I*n*	Baud Rate	Write	Set n to values 1, 2, 3, or 4 based on desired baud rate. I1 = 9,600 I2 = 19,200 (default) I3 = 57,600 I4 = 115,200 I5 = 230,400

Simple Motion Interrupt – set to turn on the motion interrupt pin (pin 3, J8 on OPS242, pin 6, J5 OPS241). The pin is high when no motion is present and low when motion is detected. The interrupt can be filtered on speed (R>*n*, R<*n*), signal magnitude (M>*n*, M<*n*), and direction (R+, R-, R|). Figure 7 shows how filtering can allow detection for certain objects and mask out others.

Command	Name	R/W	Value
IG	Motion Interrupt	Write	Turn motion interrupt on. Use "Ig" to turn off.

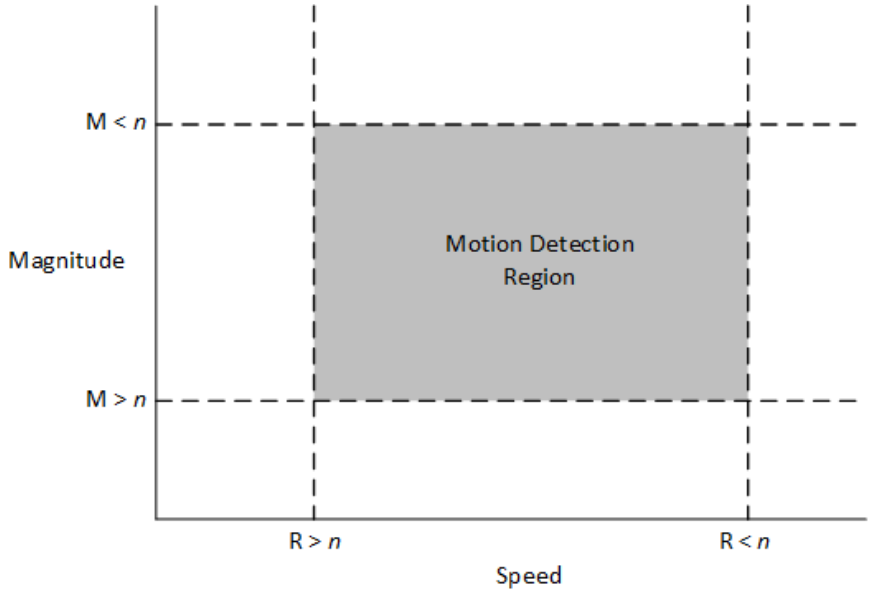

Figure 7. Speed and Magnitude Filtering

Clock – set to control the reporting of the time. The time is measured in seconds/milliseconds from power on of the module. Use the OT command to report the time in seconds and milliseconds. When the module is put in low power state (PI), the clock will continue counting. If you wish for the module to provide "the real time", then set it to "the Unix Epoch time" (see wikipedia.org/wiki/Unix_time).

Command	Name	R/W	Value
C?	Query Time	Read	Ex. {"Clock":"50"} reports 50 seconds since power on.
C=*n*	Set Time	Write	Reset the clock start time. For example, n = 10 will start the clock at 10 seconds and then continue counting.

Module/Transmit Power – set to control the operating mode (PA, PI, PP) or the transmit power. The typical maximum transmit power is 9 dB. Reducing the transmit power does not reduce the overall power consumption of the module. Note that the detection range will decrease with decreased transmit power.

Command	Name	R/W	Value
PA	Active Power Mode	Write	Normal operating mode.
PI	Idle Power Mode	Write	No activity, waits for Active Power command. The RF is powered down for further power savings.
PP	Single Shot Mode	Write	Use this mode to capture and process a single buffer of data. The module will stay in PP mode until either a PA or PI command is given. While in PP mode, the RF device is powered off to save power.
P7 or PN	Transmit Power Control or Min Power	Write	Transmit is set at -9 dB below max power.
P6	Transmit Power Control	Write	Transmit is set at -6 dB below max power.
P5	Transmit Power Control	Write	Transmit is set at -4 dB below max power.
P4	Transmit Power Control	Write	Transmit is set at -2.5 dB below max power.
P3 or PD	Transmit Power Control or Mid Power	Write	Transmit is set at -1.4 dB below max power. PD has additional "overdrive" of 0.2 dB when utilized.
P2	Transmit Power Control	Write	Transmit is set at -0.8 dB below max power.
P1	Transmit Power Control	Write	Transmit is set at -0.4 dB below max power.
P0 or PX	Transmit Power Control or Max Power	Write	Transmit power is set at its maximum value with maximum range. PX has additional "overdrive" of 0.2 dB when utilized.
PO	Transmit Off	Write	Turn transmit off and put in sensor in receive only mode. Use P! to turn transmit back on.
P!	System Reset	Write	Full system reset. ?? will time reset?

Duty Cycle Control – set to control the duty cycle operation. The time set is the amount of time the module will sleep between transmit/receive pulses and processing. During the sleep time the orange LED will be on. For settings longer than 1 second, the RF will be powered off to save power. In this manner, lower power operation may be achieved.

Command	Name	R/W	Value
Z0	Sleep 0 Second	Write	Use to set back to normal operation.
ZI	Sleep 1 Second	Write	
ZV	Sleep 5 seconds	Write	
ZX or Z1	Sleep 10 seconds	Write	
ZL	Sleep 50 seconds	Write	
ZC	Sleep 100 seconds	Write	
Z2	Sleep 200 seconds	Write	
Z=*n*	Set Sleep Time	Write	Set the amount of time to sleep between data processing. Ex., n = 5 would set the module to sleep for 5 seconds (RF powered off) between a transmit/receive pulse and processing.

Magnitude Control – provides control over the sensitivity of the module to detect moving objects. Low numbers are most sensitive, high numbers are least sensitive. Magnitude is related to Squelch as the square root of the number. For example, a magnitude setting of 10 is equal to a Squelch setting of 100 (QI).

Command	Name	R/W	Value
M>*n*	Low Magnitude Filter	Write	*n* is any number upon which no detected magnitudes below that number will be reported. M>0 resets to no limit.
M<*n*	High Magnitude Filter	Write	*n* is any number upon which no detected magnitudes above that number will be reported. M<0 resets to no limit.

Squelch Control – provides control over the sensitivity of the module to detect moving objects. Low numbers are most sensitive, high numbers are least sensitive. Squelch setting numbers are related to magnitude as the square of the magnitude. For example, squelch setting of 100 (QI) will report only signals with magnitude ≥ 10.

Command	Name	R/W	Value
QI	Squelch Control - 100	Write	Default setting, very high sensitivity.
QV	Squelch Control - 500	Write	
QX	Squelch Control – 1,000	Write	
QL	Squelch Control – 5,000	Write	
QC	Squelch Control – 10,000	Write	
Qn	Squelch Control	Write	Set *n* to the desired squelch number x 10,000. For example, setting to Q2 will set the value to 20,000. Valid values of *n* are 0-6. 0 provides no squelch control and all data will be reported.
Q=n	Squelch Control	Write	n = any arbitrary number between 1 (most sensitive) and 65,536.
Q>*n*	Low Squelch Filter	Write	*n* is any number upon which no detected magnitudes below that number will be reported. Q>0 resets to no limit.
Q<*n*	High Squelch Filter	Write	*n* is any number upon which no detected magnitudes above that number will be reported. Q<0 resets to no limit.

Persistent Memory – saves current configuration into flash memory and is retained even if power is removed.

Command	Name	R/W	Value
A!	Save Configuration	Write	Saves current configuration settings in flash memory. Upon power loss or recycling power, the saved configurations will be used as the default.
A.	Read Settings	Write	Read the current flash settings.
AX	Reset Flash Settings	Write	Will overwrite current saved settings and return to the factory default settings.

Debug Modes – provides debug information about the module.

Command	Name	R/W	Value
DR/Dr	Red LED	Write	DR to turn on red LED, Dr to turn off.
DY/Dy	Yellow LED	Write	DY to turn on yellow LED, Dy to turn off.

Appendix

Table 3. Feature versus Code Version Matrix

Feature	V1.1.1	V1.2.0	V1.2.1	V1.3.0	V1.3.1	V1.3.2	V1.3.3	Notes
Module Information	•	•	•	•	•	•	•	
Module Part Number	•	•	•	•	•	•	•	
Firmware Version	•	•	•	•	•	•	•	
Firmware Build	•	•	•	•	•	•	•	
Speed Output Units	•	•	•	•	•	•	•	
Data Precision	•	•	•	•	•	•	•	
Sampling Rate	•	•	•	•	•	•	•	
Buffer Size	•	•	•	•	•	•	•	
Reported Speed Filter	•	•	•	•	•	•	•	V1.3.0 enhanced with min/max
Reported Direction Filter	•	•	•	•	•	•	•	
Frequency Control	•	•	•	•	•	•	•	OPS242 limited to 24-24.25GHz
Frequency Reporting	•	•	•	•	•	•	•	
256 Buffer Size		•	•	•	•	•	•	
LED Control		•	•	•	•	•	•	
Number Reports		•	•	•	•	•	•	
Magnitude Report		•	•	•	•	•	•	
Speed Report		•	•	•	•	•	•	
Time Report		•	•	•	•	•	•	
Zero Reporting		•	•	•	•	•	•	
Timing Report	•	•	•	•	•	•	•	
Module Power	•	•	•	•	•	•	•	
Transmit Power	•	•	•	•	•	•	•	
Duty Cycle Control	•	•	•	•	•	•	•	
Squelch Control	•	•	•	•	•	•	•	Corrected values in V1.1.1
Quash Control	•	•	•					
Debug Modes	•	•	•	•	•	•	•	
UART Interface				•	•	•	•	
Maximum Speed				•	•	•	•	
Motion Interrupt					•	•	•	
Min/Max Magnitude Filter					•	•	•	
Watchdog Timer					•	•	•	
Persistent Memory						•	•	
System Reset						•	•	

Revision History

Version	Date	Description
A	Apr. 19, 2017	Initial release.
C	Nov. 16, 2017	Added changes incorporated into V1.1.1 • New API reporting frequency setting • Default Squelch setting change to 100 • Corrected Squelch codes • Faster lock time to set frequency
D	August 12, 2018	Added changes incorporated into V1.2.0 • Support for OPS242-A added • Added frequency reporting API command • LED on/off control • Number of reports provided • Magnitude report control • Speed report control • Time report control • Updated reported Module information (??) • Clarified restrictions on the frequency setting for OPS242 • 256 buffer size support • Added BZ command information
E	September 24, 2018	Added changes incorporated into V1.2.1 • Updated OPS242 frequency range support for FCC approval • Corrected Squelch (Q) setting range
F	October 18, 2018	Added changes incorporated into V1.3.0 • UART interface support with API control • Removed Quash feature • Added maximum speed filter
G	November 14, 2018	Added changes incorporated into V1.3.1 • Simple motion detection interrupt • Magnitude filter (M>*n*, M<*n*) • Watchdog timer added • Reset Reason (?R) added • Unique board ID (?U) • Tighter tuning tolerance • Modified the JSON output of "??", "?S", "I?", "P?", "S?, "R?", and "Q?"
H	December 19, 2018	Added changes incorporated into V1.3.2 • Added Persistent memory (A!) • Enabled system reset (P!)
J	March 11, 2019	Added changed incorporated into V1.3.3 • Fixed frequency calibration issue which could cause out of frequency lock • Corrected simple motion interrupt (“IG”) pin for OPS241